Co-Digestion of Food Waste and Garden Waste With WTTP Mixed Sludge in CSTR

Fitamo, Temesgen Mathewos; Boldrin, Alessio; Boe, Kanokwan; Angelidaki, Irini; Scheutz, Charlotte

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DTU Environment
Department of Environmental Engineering

Technical University of Denmark

Co-digestion of food and garden waste with mixed sludge from wastewater treatment in continuous stirred tank reactors

Fitamo, T. , Boldrin, A., Boe, K., Angelidaki, I., Scheutz, C.

Background and objective

Background

Biogas production is expected to increase in many countries and play an important role in future energy systems due to increasing demand of renewable energy. Additional types of biomass will have to be synergistically exploited, including organic waste originating from urban areas to catch up with political targets set up by many countries.

The addition of co-substrates into existing sewage sludge based AD reactors has the potential to significantly increase biogas production that will in turn lead to increased net energy generation of WWTP while ensuring management of the waste at a local level and possibly improving the economy of WWTP.

Objective of the study

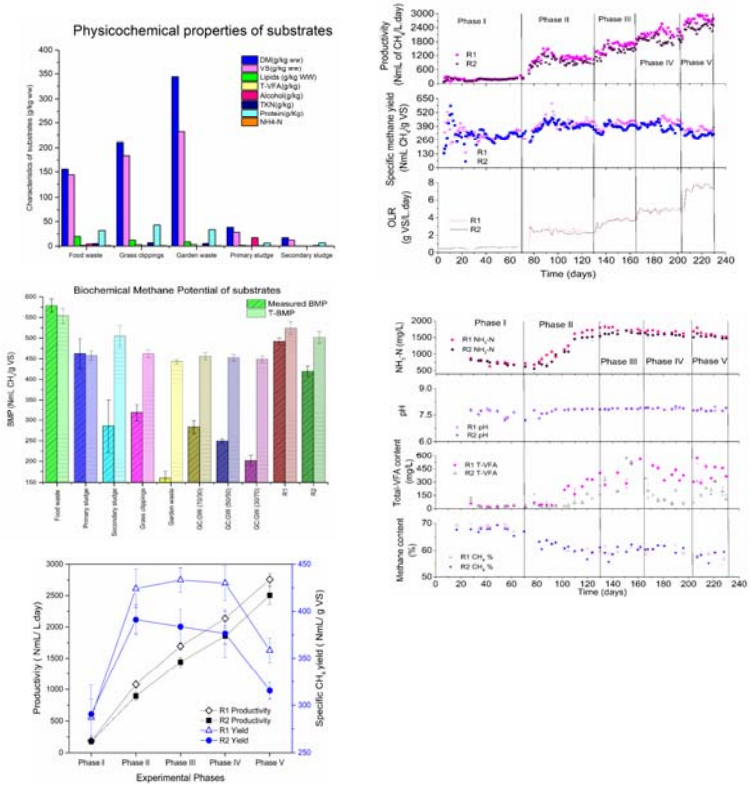
The objective was to investigate the effect of co-digestion mixing ratio between sludge, food waste, grass clippings and green waste, at different hydraulic retention time CSTR.

Methodology

- The experiment was carried out in two automated continuous stirred tank reactors (CSTRs), VS % of 10:67.5:15.75:6.75 (R1) and 10:45:31.5:13.5 (R2) respectively, each with a working volume of 7.5 L and operating temperature of 55 ^{O}C.
- Biochemical methane potential (BMP) of individual substrates was measured and theoretical BMP was calculated based on chemical components of organic waste.

Experimental set-up of co-digestion process in continuous stirred tank reactor

Results



Characterization, methane potential, CSTR operation and performance parameters

Discussion

- The maximum methane yield in batch test was obtained for food waste (579 NmL CH4/ g VS), while garden waste presents low degradability (160 NmL CH4/ g VS).
- When increasing feed rate, i.e. lower HRT from 30 to 20 and 15 days, respectively, the methane yield remained relatively constant around 430 NmL/ g VS and 376 NmL/ g VS in R1 and R2, respectively.
- Significant decrease in methane yield was observed in both reactors when the HRT was decreased to 10 days, owing to overloading and wash out of microbial community.
- Since the methane production rate improved significantly with decreasing HRT, the trade-off between yield and productivity was obtained at 15 days HRT.




Conclusions

- Compared to digestion of 100 % sludge, the methane yield increased by 48% and 35%, when co-digesting sludge with food waste, grass clippings and garden waste with corresponding VS% of 10:67.5:15.75:6.75 (R1) and 10:45:31.5:13.5 (R2), respectively.
- The methane yield remained constant with decrease in HRT (30, 20, 15) but dropped markedly when the HRT was decreased to 10 days.
- The trade-off between yield and productivity were achieved at 15 days HRT with stable process parameters.

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Contact

biochain

www.biochain.dk
www.env.dtu.dk

Contact:
Temesgen Mathewos Fitamo
Miljøvej, Building 113
2800 Kongens Lyngby
tefi@env.dtu.dk